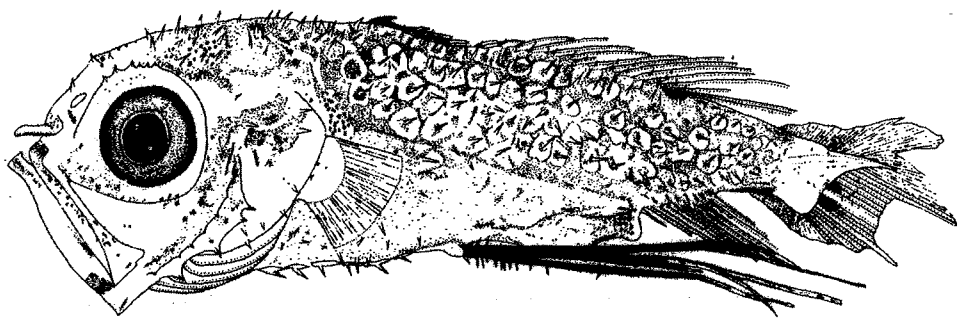
NOAA Technical Memorandum NMFS-SEFSC-499

PRELIMINARY GUIDE TO THE IDENTIFICATION OF THE EARLY LIFE HISTORY STAGES OF BERYCIFORM FISHES OF THE WESTERN CENTRAL NORTH ATLANTIC

BY

W. J. Richards, J. Lyczkowski-Shultz, & M. Konieczna



U.S. DEPARTMENT OF COMMERCE
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National Marine Fisheries Service
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It will be chapters entitled Beryciformes, Anomalopidae, Anoplogasteridae, Berycidae, Diretmidae, Holocentridae, & Trachichthyidae in the "Guide to the early life history stages of fishes of the western central North Atlantic".

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BERYCIFORMES **by W. J. Richards, J. Lyczkowski-Shultz, & M. Konieczna**

Six families of this morphologically diverse order of fishes are found in the western central North Atlantic (Anomalopidae, Anoplogasteridae, Berycidae, Diretmidae, Holocentridae, and Trachichthyidae) comprising 24 species in 15 genera. The remaining family Monocentridae does not occur in the Atlantic. Most genera have one or two species and they are listed in Table Beryciformes 1 with their meristics. Larvae resemble perciform larvae with prominent head and fin spines so great care is needed to insure correct identification. Berciforms have more than 6 pelvic fin elements whereas perciforms have 6 or fewer. Larvae are known for each family, several genera and some species. Details are given in the individual family chapters. Larvae are encountered in mixed surface layer samples throughout our area whereas most adults inhabit the full vertical extent of the oceans: epipelagic to bathybenthic. Adults of the species of the Family Holocentridae are associated with coral reefs and most often only encountered at night as they are nocturnal.

The order has been the subject of several rearrangements in the last decade and details are summarized in Nelson (1994). We follow Johnson & Patterson (1993) in recognizing two orders: the Beryciformes and the Stephanoberyciformes. All the larval forms of both orders bear some resemblances to one another especially the precocious pelvic fin rays. Our earlier paper (Lyczkowski-Shultz et al. 2000) included three stephanoberyciform families in the Beryciformes and the Family Polymixiidae as we followed earlier authors. In addition, Baldwin & Johnson (1995) reviewed larval data to demonstrate the differences between the two orders. Since then Paxton et al. (2001), described the larvae of two more stephanoberyciform families. Baldwin & Johnson (1995) note that head spination is a prominent feature of beryciform larvae whereas spines are nearly lacking in stephanoberyciforms. The presence/absence of head spines are given in the individual family accounts and head spine definitions are given in Figure Anomalopidae 1.

Table Beryciformes 1. Species and their meristic characters for Beryciform fishes. Families are in alphabetical order here & in the text.
Data sources are Woods & Sonoda 1973, Colin et al. 1979, Post & Quero 1981, Ebeling & Weed 1973, Mundy 1990, Watson 1996ad, and Kotlyar 1996.

	Fin Elements								
Species	1st Dorsal	2nd Dorsal	Anal	Pectoral	Pelvic	Caudal	Vertebrae	Branchiostegals	Gillrakers
Anomalopidae									
Kryptophaneron									
alfredi	IV	I-II,14	II-III,10	16-17	I,6	VII-20(?)-VII	16+14/12+17=29-30	8	6-7+1+17-19=24-25
Anoplogtasteridae									
Anoplogaster									
cornuta		17-19	7-9	13-16	I,6	IV-VI,ii,9-8,ii,VI-VII	12+13-15=25-27	8	5-10+1+7-12=16-23
brachycera		16-17	8	13-15	I,6	9		8	7-8+1+9-11=17-20
Berycidae									
Beryx									
decadactylus	III-IV	16-21	III-IV,25-30	14-18	I,9-10	IV,ii,9-8,ii,IV	24	8	5-8+1+15-19=20-26
splendens	III-IV	12-15	IV,25-30	15-19	I,10-13	V,i,9-8,i,V	24	8	5-7+1+15-20=22-28
Diretmidae									
Diretmus									
argenteus		25-29	20-24	16-20	I,6	III-IV,ii-iii,9-8,ii-iii,III	11-14+15-17=28-30	8(7<40mm)	6-9+1+10-14=17-22
Diretmoides									
pauciradiatus		24-27	18-21	16-19	I,6	III,iii,9-8,iii,III	12-14+=27-30	8(7<40mm)	4-6+1+7-10=12-16
Diretmichthys									
parini		26-30	20-23	17-19	I,6		13-15+=29-32		5-7+1+11-13=18-20
Holocentridae									
Holocentrus									
adscensionis	XI	14-16	IV,10	15-17	I,7	V,ii,9-8,ii,IV	27	8	8+1+14-15=23-25
rufus	XI	14-16	IV,9-11	15-17	I,7	V,ii,9-8,ii,IV	27	8	8-9+1+15-17=24-26
Neoniphon									
marianus	X-I	12-13	IV,8-9	14-14	I,7		27	8	6-8+1+11-13=19-20(18)
Sargocentron									
vexillarium	XI	12-14	IV,8-10	14-15	I,7	V,ii,9-8,ii,IV	27	8	17-19
coruscum	XI	11-13	IV,8	12-13	I,7	V,ii,9-8,ii,IV	27	8	15-18
bullisi	XI	11-12	IV,8	13-15	I,7	V,ii,9-8,ii,IV	27	8	16-17
poco	XI	13	IV,8-9	13-14	I,7	V,ii,9-8,ii,IV	27	8	18-20
Myripristis									
jacobus	X-I	13-15	IV,12-13	14-15	I,7	IV,ii,9-8,ii,III	11+15=26	8	27-32
Ostichthys									
trachypoma	XI,I	13-14	IV,10-12	14-16	I,7	IV,ii,9-8,ii,III	11+15=26	8	23-25
Corniger									
spinosus	XI,I	13-14	IV,9-12	16-17	I,7	IV,ii,9-8,ii,III	27	8	18-21
Plectrypops									
retrospinis	XI,I	13-14	IV,10-12	16-18	I,7	IV,ii,9-8,ii,III	26	8	23-27
Trachichthyidae									
Gephyroberyx									
darwini	VII-IX	12-15	III,10-12	13-16	I,6	VI,ii,9-8,ii,VI	26	8	4-7+1+9-14=15-23
Hoplostethus									
atlanticus	V-VI	15-19	II-III,10-12	16-20	I,6	VI-VIII,ii,9-8,ii,VI-VIII	13+16=29	8	5-7+1+11-14=17-22
mediterraneus	VI-VII	12-14	III,9-11	14-16	I,6	VI,ii,9-8,ii,VI	26	8	6-8+1+12-17=20-26
occidentalis	IV-VIII	12-14	II-III,8-10	14-18	I,6	VI,ii,9-8,ii,VI	26	8	5-6+1+12-14=18-22
Paratrachichthys									
argyrophanus	V	12-14	II,9-10	11-13	I,6	VI,ii,9-8,ii,VI	26	8	5-6+1+10-12=16-18

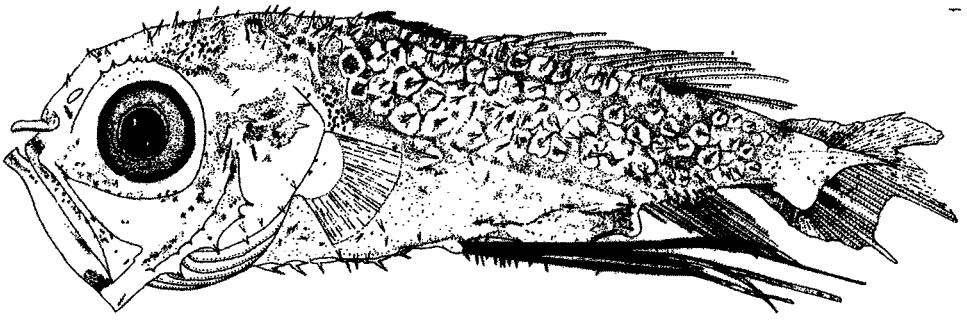
ANOMALOPIDAE: Flashlight fishes

by W. J. Richards, J. Lyczkowski-Shultz, & M. Konieczna

Species in this family of small, unusual fishes possess a large light organ below the eye where a culture of luminous bacteria reside and with a shutter mechanism to control light emission (Nelson 1994). One species occurs in our area, *Kryptophanaron alfredi*, while an additional 4 genera and 5 species occur in the Indo-Pacific (Nelson 1994). Adult *K. alfredi* have been observed and collected by SCUBA divers at night at depths ranging from 27 to 76 m while feeding and possibly spawning along the crest of vertical or steeply sloping reef walls of Caribbean islands (Colin et al. 1979). These authors speculated that *K. alfredi* spends daytime hours at greater depths beyond the range of SCUBA divers and over habitat unsuitable for trawling. Baldwin & Johnson (1995) described a larva of *K. alfredi* together with a discussion of beryciform and stephanoberyciform larvae. They characterize the *K. alfredi* larva as having an elongate, heavily pigmented pelvic fin; a patch of pigment on and between the anteriormost dorsal-fin spines; numerous melanophores covering the head and trunk but conspicuously absent on the caudal peduncle; prominent head spines and spiny scales. The larva lacks light organs, but an antrorse projection on each side of the snout represents at least a stalk of an incipient light organ (Figure Anomalopidae 1). Colin (1989) fertilized eggs from two Pacific genera and illustrated early larvae. He noted that the eggs were 1.0-1.3 mm in diameter with a mucous sheath. The newly hatched larvae were slender, well pigmented and had precocious pelvic fins.

The meristic characters are given in Table Beryciformes 1 and the illustration of the larva and head spines are shown below in Figure Anomalopidae 1. Anomalopids have the following head spines: supramaxilla, dentary, infraorbitals, nasal, frontal, supraorbital, parietal, pterotic, extrascapula, posttemporal, lateral preopercular, medial preopercular, non serrate ridge on the opercle; they lack spines on the maxilla, retroarticular, angulo-articular, supraoccipital, and supracleithrum (Baldwin & Johnson1995). Additional salient characters include tack-like scales, ventral scutes and fin spinules on the dorsal, anal, pelvic and caudal fins (Baldwin & Johnson1995).

Figure Anomalopidae 1. Illustrations from Baldwin & Johnson 1995 of A) larval *Kryptophanaron alfredi* 6.2 mm NL; B) head spination in the larval *K. alfredi*. Abbreviations are: F-frontal, So-supraorbital ridge of frontal, Na-nasal, Me-mesethmoid, Le-lateral ethmoid stalk, La-lacrimal, Mx-maxilla, Pmx-premaxilla, D-dentary, Aa-anguloarticular, Smx-supramaxilla, Ra-retroarticular, Io_n-n^{th} infraorbital, Br-branchiostegal, Preop-preopercle, Iop-interopercle, Sop-subopercle, Op-opercle, Op-opercle, Scl-supracleithrum, Pt-posttemporal, Ex-extrascapular, Pa-parietal, Pe-pterotic.



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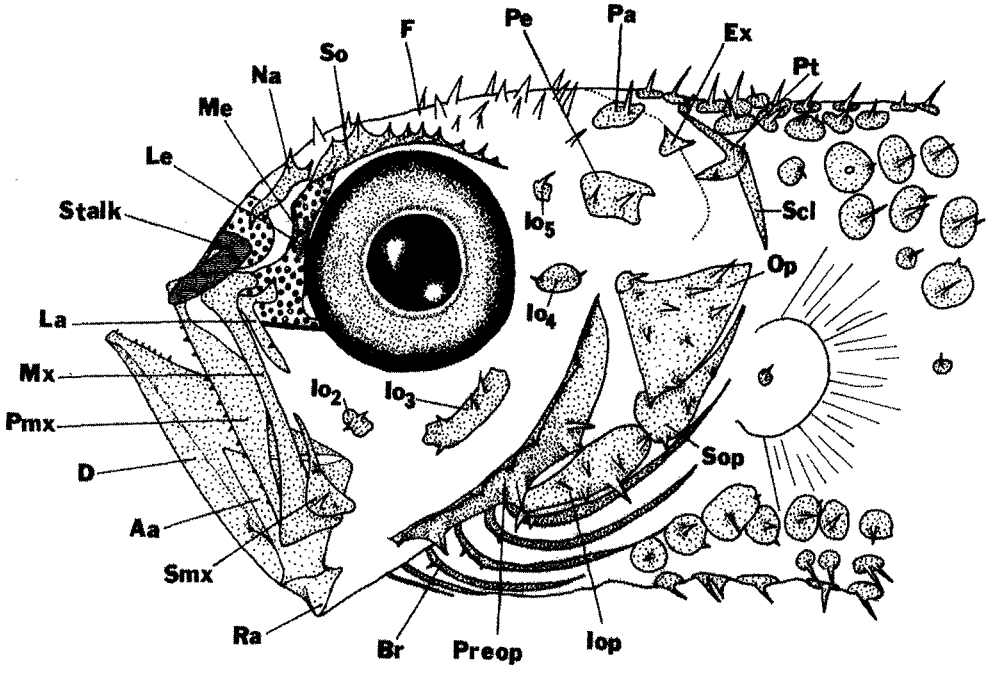


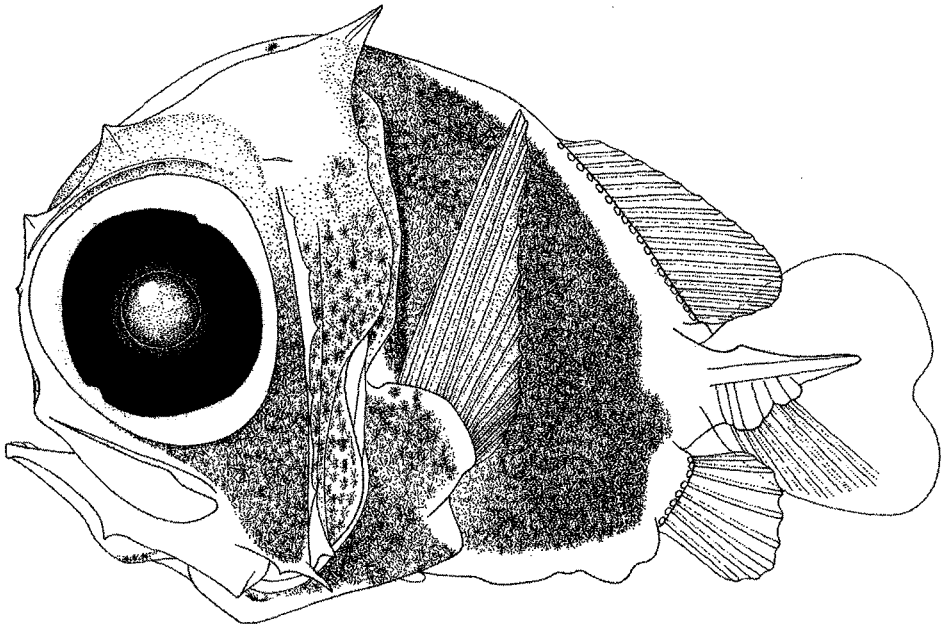
B

ANOPLOGASTERIDAE: Fangtooths by W. J. Richards, J. Lyczkowski-Shultz, & M. Konieczna

Two species comprise this meso-bathypelagic family and both occur in our area (Kotlyar 1986, 2003). Adults are deep bodied with a broad head and compressed posterior trunk, with very long fang-like, canine teeth, and relatively small eyes. The young stages were considered a separate genus (*Anoplogaster*) from the adults (*Caulolepis*) because of strong head spines similar to those found in diretmid young. Diretmids have greater numbers of dorsal and anal fin rays thus separation is easy. Other fishes with large head spines include istiophorids and dactylopterids, but in both of those families the parietal & preopercular spines are directed posteriad along the body and both lack spines above the eyes. Scorpaenids, triglids, and peristediids have long parietal spines and some have spines above the eyes, but not elongate preopercular spines. These families differ in many meristic features (refer to appropriate tables).

Anoplogaster cornuta has the long head spines whereas *A. brachycera* has short head spines in the young stages (basis for its designation as a separate species by Kotlyar 1986). Keene & Tighe (1984) describe the young stages of *A. cornuta* and Kotlyar (1986) provides full descriptions and illustrations of both species. We provide an illustration of a 4.0 mm NL specimen that has not developed the long spines seen in the 6.0 mm NL specimen from Keene & Tighe (1984) also reproduced here together with some illustrations from Kotlyar (1986) in Figures Anoplogasteridae 1-2. Our small 4.0 mm specimen has fin counts within the range of *A. cornuta*. Meristic characters are given in Table Beryciformes 1. *A. cornuta* ranges from the Gulf of Maine south along the U. S. east coast, Bermuda, Bahamas, Gulf of Mexico, & Caribbean Sea over a wide depth range of 45 m to 4900 m. *A. brachycera* is rare in our area with two records from northeast of the Bahamas. Specimens illustrated by Kotlyar (1986) and shown here in Figure Anoplogasteridae 2 were caught in the Sulu Sea, Pacific Ocean basin, with young at depths of 200 m, adults bathypelagic from 1000 to 1500 m.

Figure Anoplogasteridae 1. Illustrations of young *Anoplogaster cornuta*. A) 4.0 mm NL (original); B) 4.0 mm late preflexion larva from Watson (1996 ae); C) 4.3 mm flexion larva from Watson (1996 ae);D) 6.0 mm SL from Keene & Tighe (1984); E) 19.0 mm from Kotlyar (1986), F) 31.0 mm from Kotlyar (1986).



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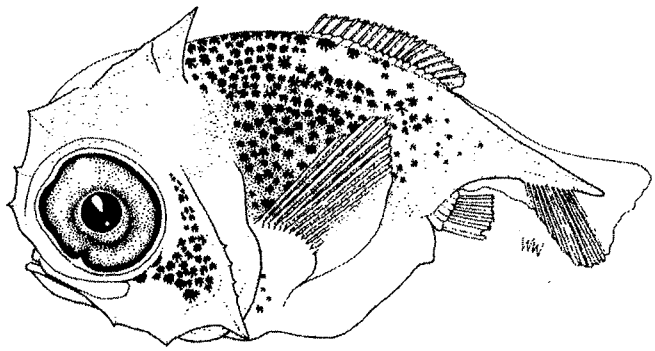

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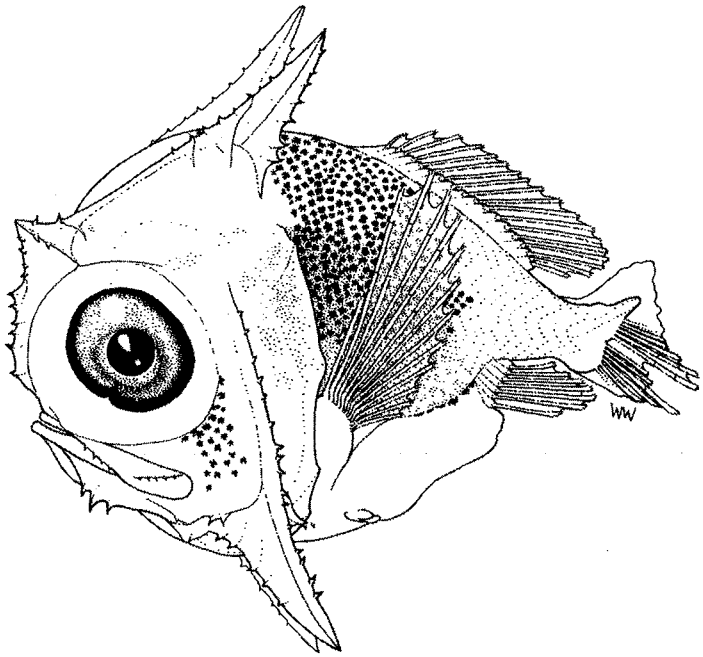

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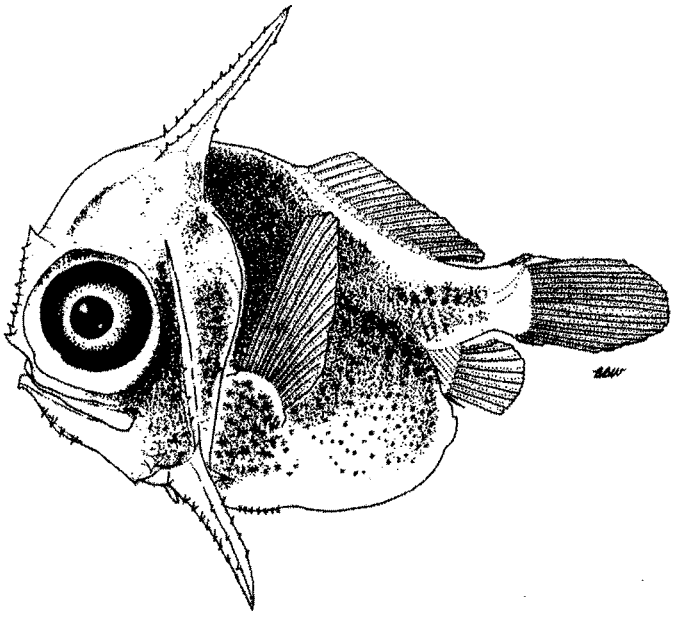

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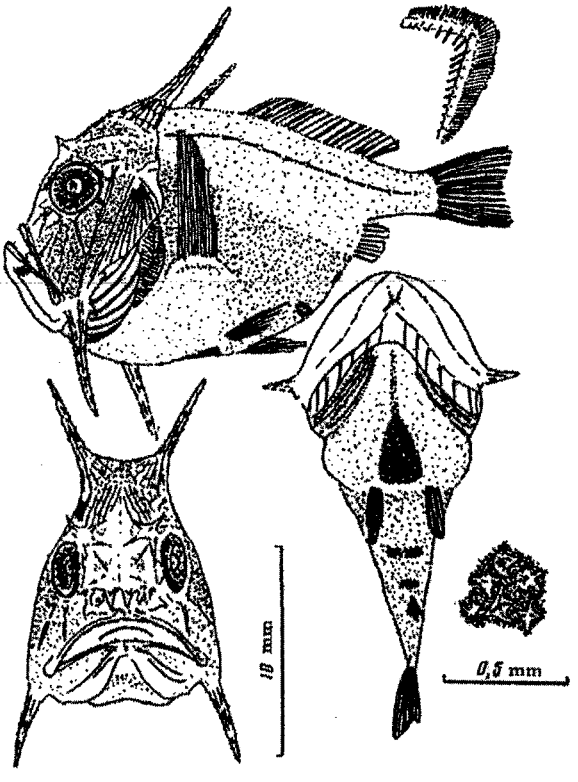

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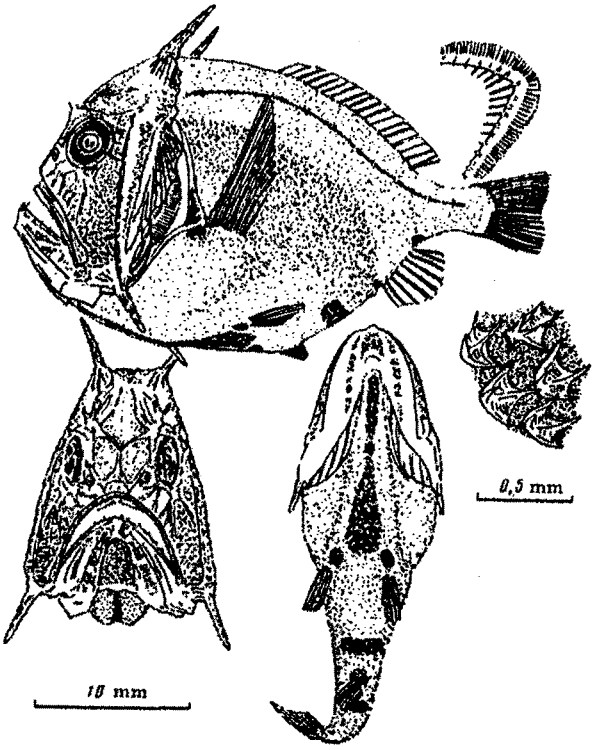

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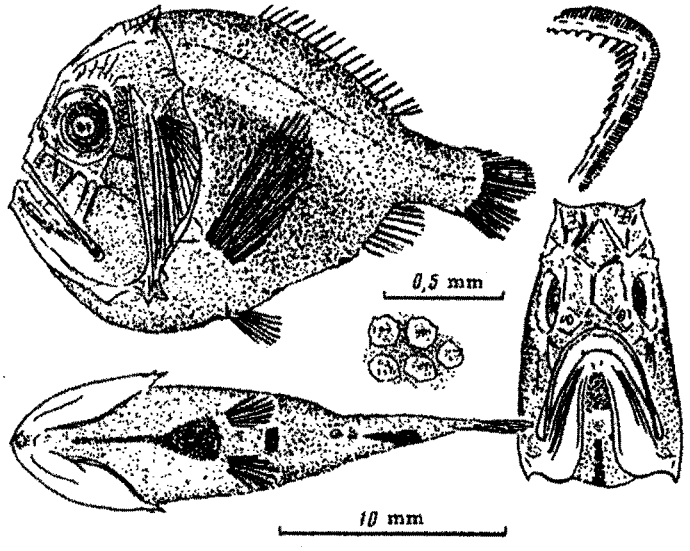
Figure Anoplogasteridae 2. Illustrations of young *Anoplogaster brachycera* from Kotlyar (1986). A) 20.0 mm & B) 34.0 mm. Specimens are from the Sulu Sea.



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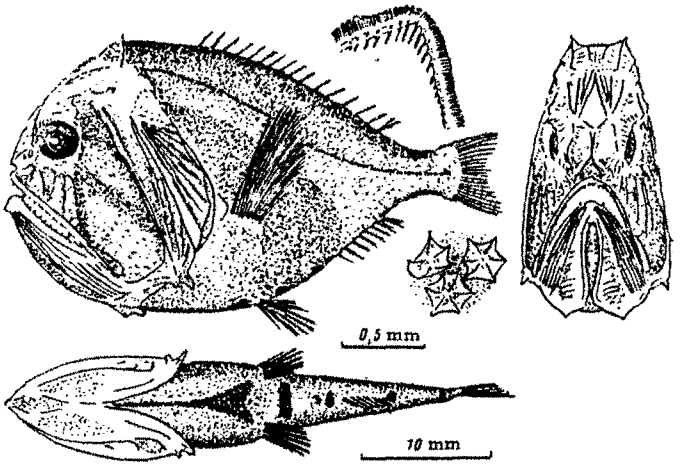


Two species of berycids (*Beryx splendens* and *B. decadactylus*) are found in our area though elsewhere there is another genus and several more species. These two species are found in tropical and temperate seas of all oceans. Mundy (1990) described larvae of *Beryx* spp. and late larvae and juveniles of both species. Most of his material was from the central Pacific, but is applicable to our area. Mundy (1990) reviews the history of ELH identifications and descriptions.

Beryx yolk-sac larvae according to Mundy (1990) are identified from the following combination of characters: 23 myomeres, uncoiled intestine, preanal length ca. 50% SL, early forming pelvic fin buds, pigment restricted to forebrain and midbrain, anterior edge of oil globule, end of the intestine, and around tip of notochord. Larger larvae have very long, early forming pelvic rays and anterior dorsal elements, slightly curved intestine, preanal length 45-56% SL, and sparse pigment. *Beryx* larvae resemble melamphaiid larvae, particularly *Melamphaes*, but differ in pigment pattern, meristics, and head spination (Mundy 1990). Meristic data are given in Table Beryciformes 1. Baldwin & Johnson (1995) review the head spination of larval Beryx and report head spines or serrate features on most bones except the parietal, branchiostegals, supraoccipital, supracleithrum, opercle, subopercle, & interopercle with the medial preopercle questionable. They also note that *Beryx* lacks modified scales and scutes & fin spinules. Miskiewicz & Trnski (2000) also review berycids for Indo-Pacific waters.

Mundy (1990) could not identify berycid larvae to species less than 6.0 mm SL because the differentiating character is the number of softrays in the second dorsal fin (16-21 in *B. decadactylus* and 12-15 in *B. splendens*) (see Table Beryciformes 1). These small *Beryx* spp. larvae are shown in Figure Berycidae 1. *Beryx decadactylus* larva and its head spination are shown in Figure Berycidae 2 and *B. slendens* larvae in Figure Berycidae 3. Both species are found circumglobally in warm temperate & tropical seas but are absent from the eastern Pacific, *B. splendens* does not occur in the Mediterranean. Little is known of their biology as they are infrequently caught and are rare in collections. Capt. Ron Schatman has caught fair numbers in the Bahamas fishing on the bottom in ca. 300 m and has given a few specimens to one of us (Richards). They are highly marketable because of nice flesh.

Figure Berycidae 1. *Beryx* spp. illustrations are from Mundy (1990) as follows: A) 2.1 mm NL; B) 3.0 mm NL; C) 3.3 mm NL; D) 4.0 mm NL; E) 4.6 mm SL; F) 5.0 mm SL; G) 5.2 mm SL.

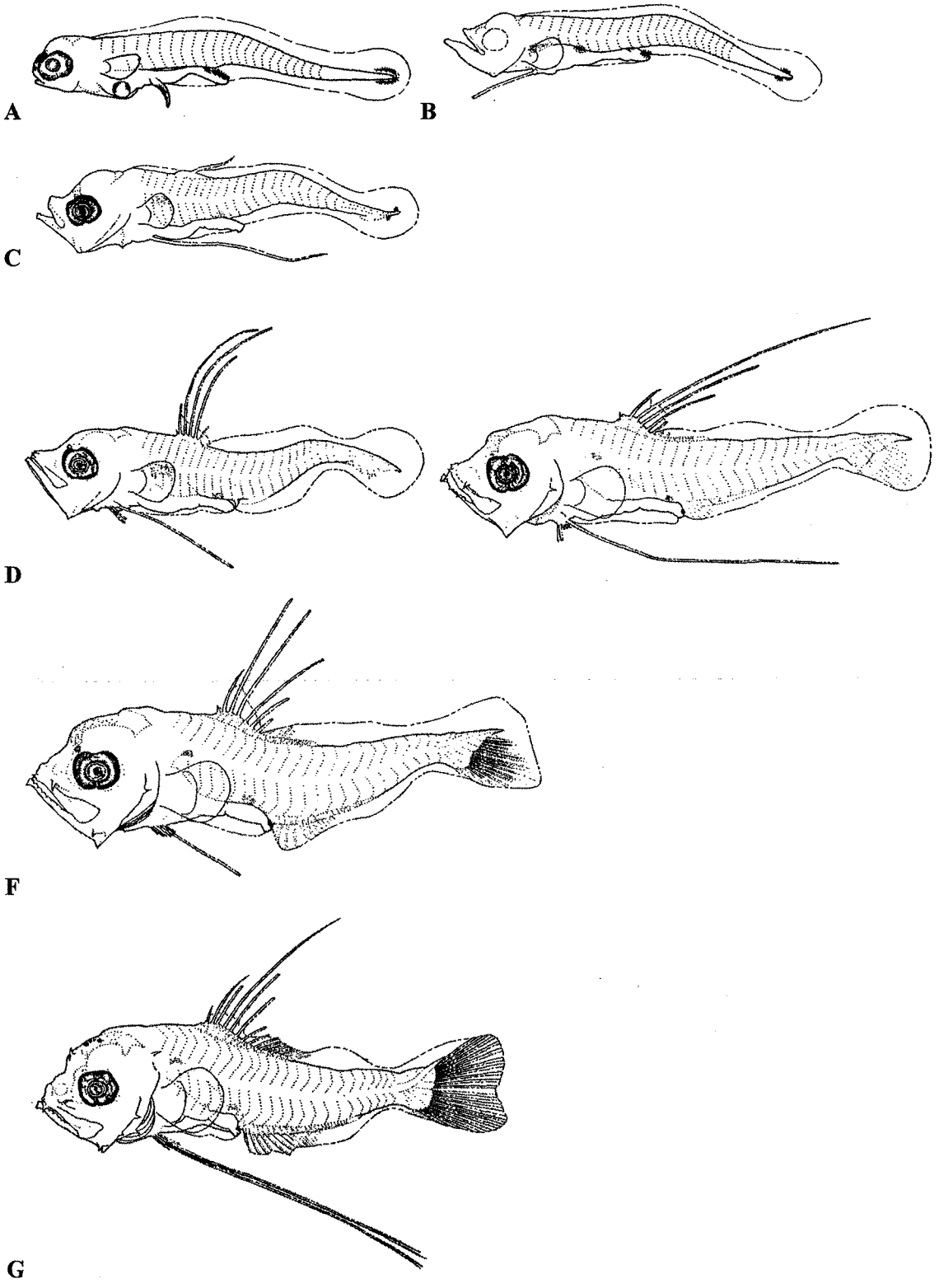
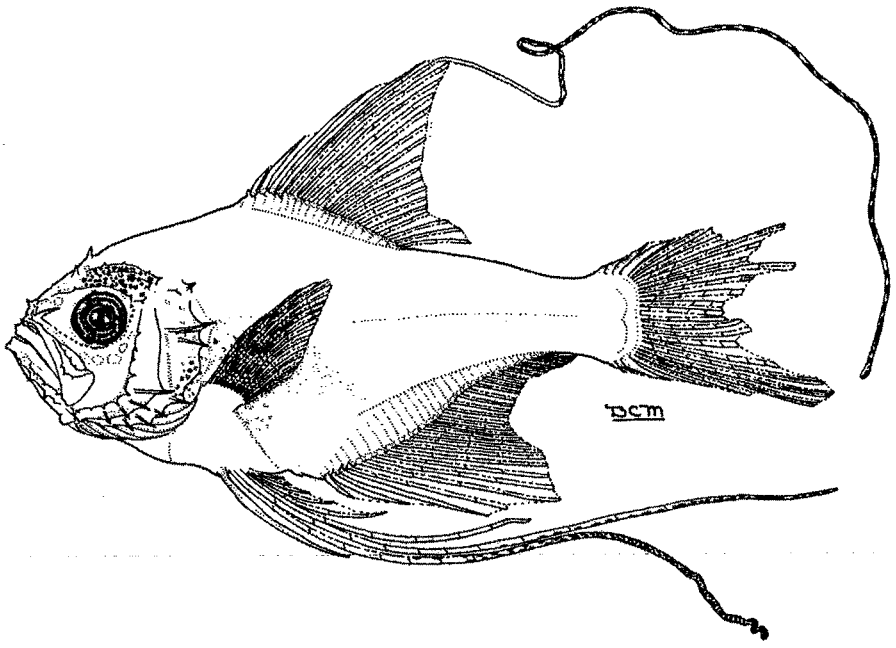


Figure Berycidae 2. *Beryx decadactylus* from Mundy (1990). A) 16.4 mm SL, North Atlantic, MCZ 064863; B) Details of head spines of A: Aa-anguloarticular, Apo-anterior preopercle, D-dentary, F-frontal, Fso-supraorbital ridge of frontal, I-infraorbital, I1-first infraorbital, Io-interopercle, Mx-maxilla, N-nasal, O-opercle, Ppo-posterior preopercle, Pt-pterotic, Ptt-posttemporal, & Ra-retroarticular.



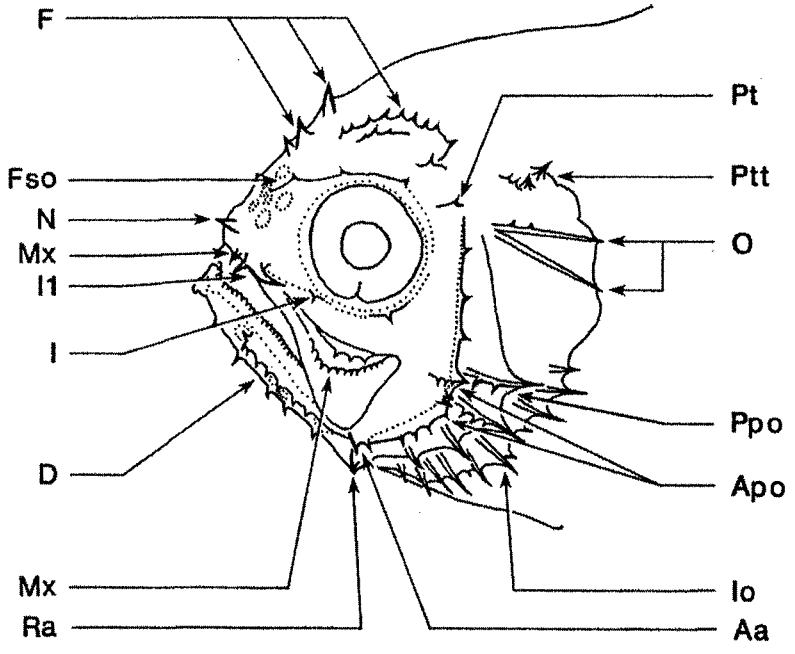
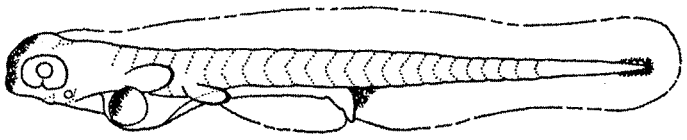


Figure Berycidae 3. *Beryx splendens* from Mundy (1990): A) Reared larva 3.0 mm SL; B) 6.0 mm SL, Pacific, Southeast Hancock Seamount; C) 7.5 mm SL, Pacific, Southeast Hancock Seamount; & D) 15.0 mm SL, North Atlantic, MCZ 068672.



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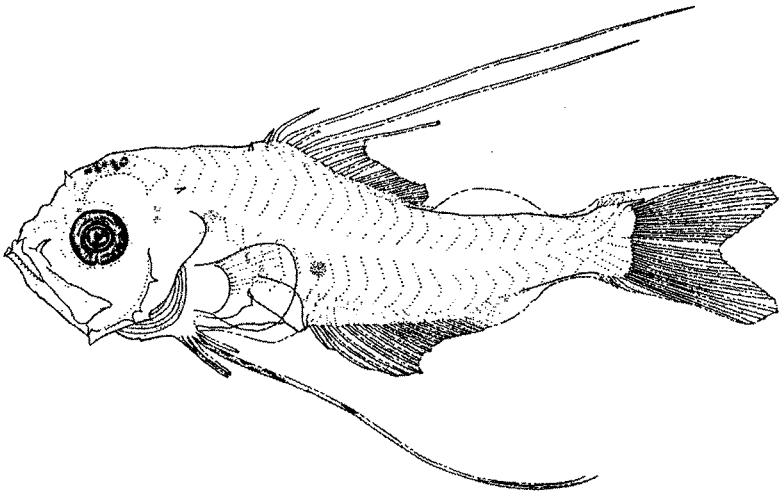

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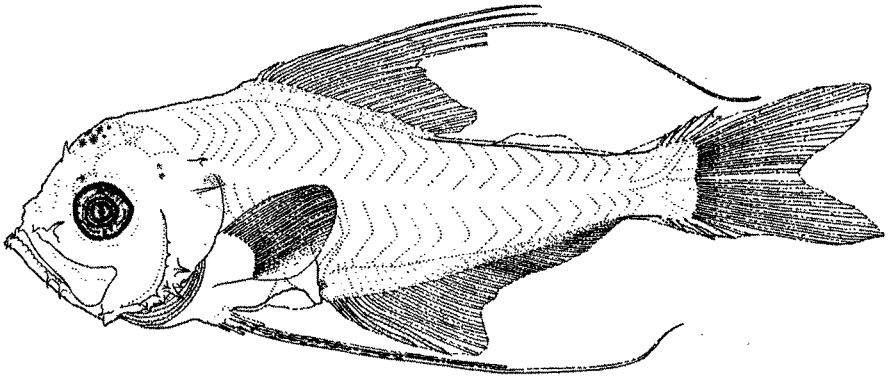

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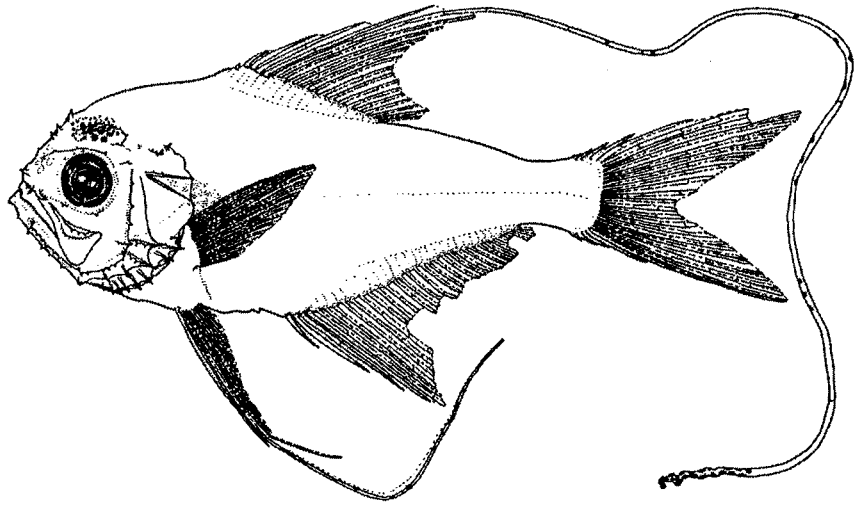
Figure Berycidae 3. Continued.



D

DIRETMIDAE: Spinyfins

by W. J. Richards, J. Lyczkowski-Shultz, M. Konieczna

A small family of meso-, bathypelagic fishes known from the Atlantic, Indian, and Pacific Oceans comprised of three genera and four species of which all but one species is known from our area. The species are listed in Table Beryciformes 1 with their meristic characters. Adults are deep bodied, compressed, with very large eyes, well-developed auditory bullae, and delicate head bones that are easily damaged. Minute spines are located near the bases of the dorsal and anal fins. Larval series are known for each species (Post & Quero 1981). The young stages are characterized by being relatively elongate at <4-5 mm then rapidly becoming deeper bodied; short, stout, rugose spine on the frontal bone over each eye; a longer, rugose, posteriorly directed, parietal spine on each side of the head; and a long, ventrally directed preopercular spine (Keene & Tighe 1984). In addition, they lack spines on the maxilla, retroarticular,branchiostegals, supraoccipital, supracleithrum, sub-, inter-, opercle, the latter with a non-serrate ridge (Baldwin & Johnson 1995). Post & Quero (1981) provided a key to young stages that relies on the alignment of the preopercular spine and color pattern. In small larvae the preopercular spine is directed posteroventrally in *D. argenteus*, but directly ventrad or anteroventrally in the other two species. In our paper (Lyczkowski-Shultz et al. 2000) we showed a photo of a *Diretmus argenteus* that differed from described species by having a banding pattern not previously described. Post & Quero (1981) used color patterns to separate the other two species indicating that *Diretmoides pauciradiatus* has a brown spot above the posterior part of the anal fin and lacks a brownish, lateral trunk, horse shoe shaped area whereas *Diretmichthys parini* lacks the anal fin spot but has the brownish, horse shoe shaped area on its flank (best seen in Figure Diretmidae 3 G). We have reproduced the photographs from our paper together with other examples of all the species from other sources in Figures Diretmidae 1-3. The quality of the illustrations taken from Post & Quero (1981) is low, but the diagnostic features are revealed. Watson (1996ad) described *D. argenteus* from the California Current region and we include his figure of a 6.2 mm larva below (Figure Diretmidae 1, J).

Diretmid larvae could be confused with anoplogasterid larvae as both have the long parietal and preopercular head spines and deep compressed bodies. However, dorsal and anal fin rays form early and diretmids have twice as many anal rays and considerably more dorsal rays than anoplogasterid larvae (see Table Beryciformes 1). Other fishes with large head spines include istiophorids and dactylopterids, but in both of those families the parietal & preopercular spines are directed posteriad parallel with the body axis and both lack spines above the eyes. Scorpaenids, triglids, and peristediids have long parietal spines and some have spines above the eyes, but not elongate preopercular spines. These families also differ in many meristic features (refer to appropriate tables).

Figure Diretmidae 1. Illustrations of *Diretmus argenteus* ELH stages. A) *Diretmus argenteus* 6.8 mm from Lyczkowski-Shultz et al. (2000); B-I) Series of young stages from Post & Quero (1981): B - ca. 4 mm NL, C – ca. 5.7 mm SL, D – ca. 8.1 mm SL, E – ca. 12 mm SL, F – ca. 16 mm SL, G - ca. 20 mm SL, H – ca. 48 mm SL, & I – ca. 80 mm SL. J) 6.2 mm SL larva from Watson 1996ad.

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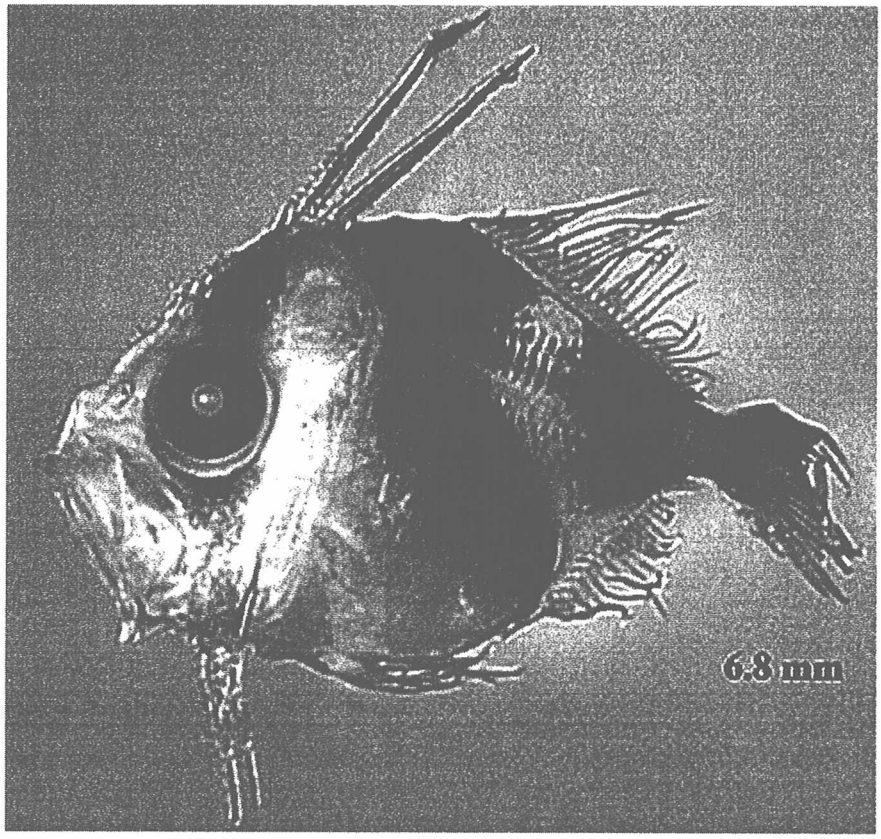

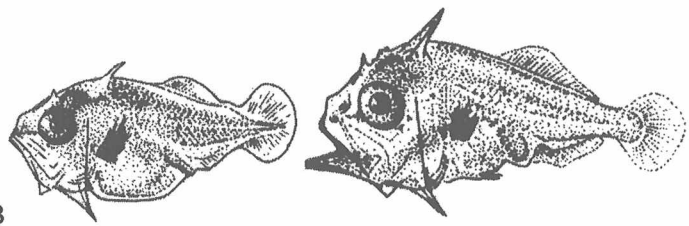

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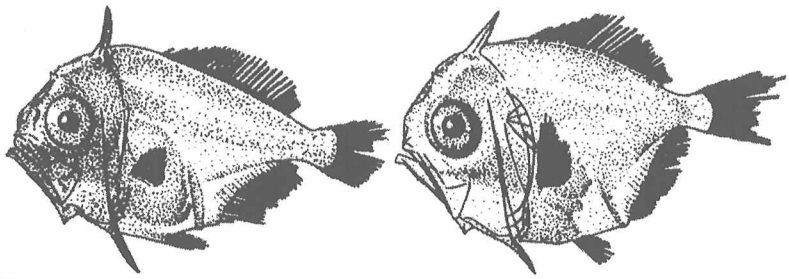

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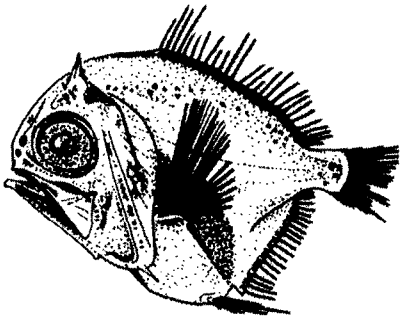
Figure Diretmidae 1. Continued.



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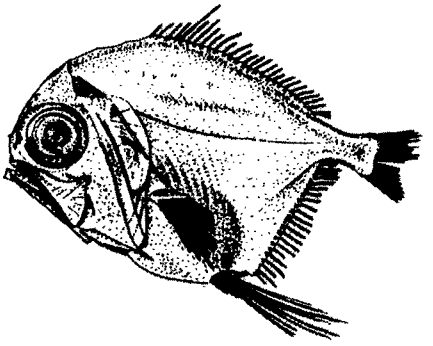

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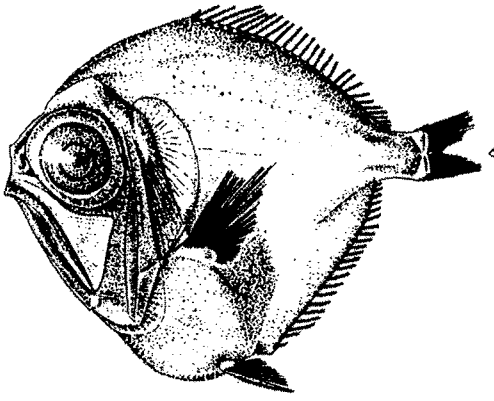

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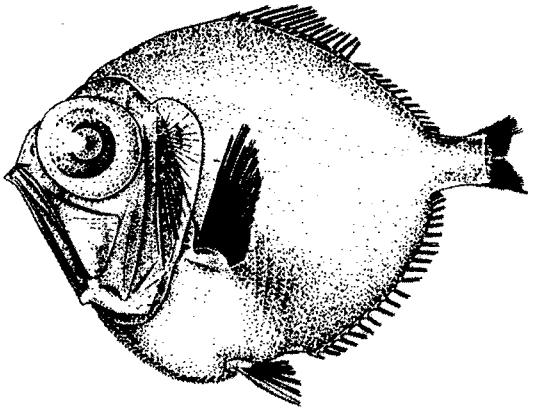

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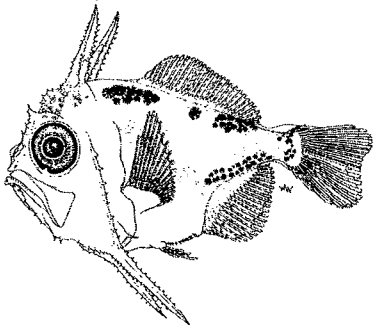

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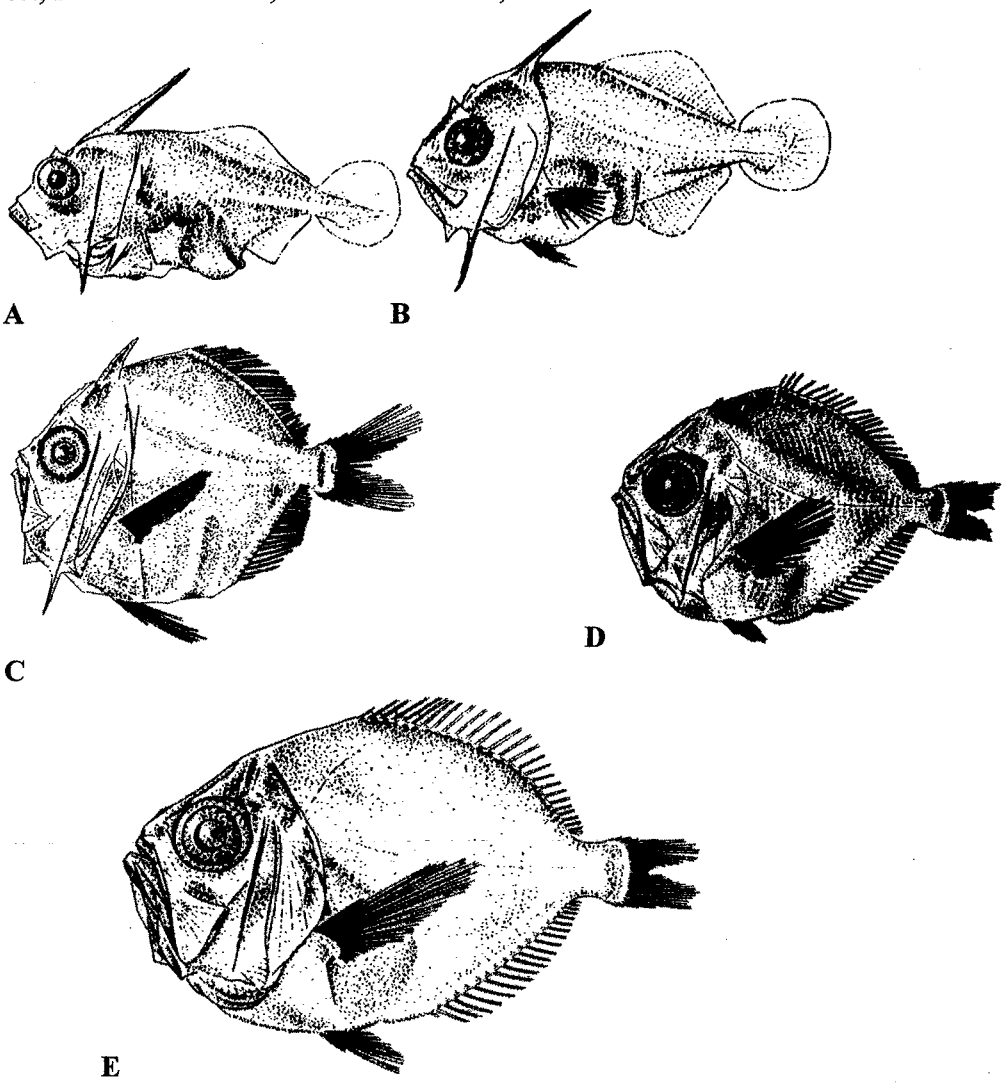
Figure Diretmidae 2. Illustrations of *Diretmoides pauciradiatus* ELH stages. A-F) Series of young stages from Post & Quero (1981). A- ca. 6 mm NL, B – ca. 9.5 mm SL, C – ca. 11.5 mm SL, D – ca. 23 mm SL, E – ca. 32 mm SL, & F – ca. 81 mm SL.



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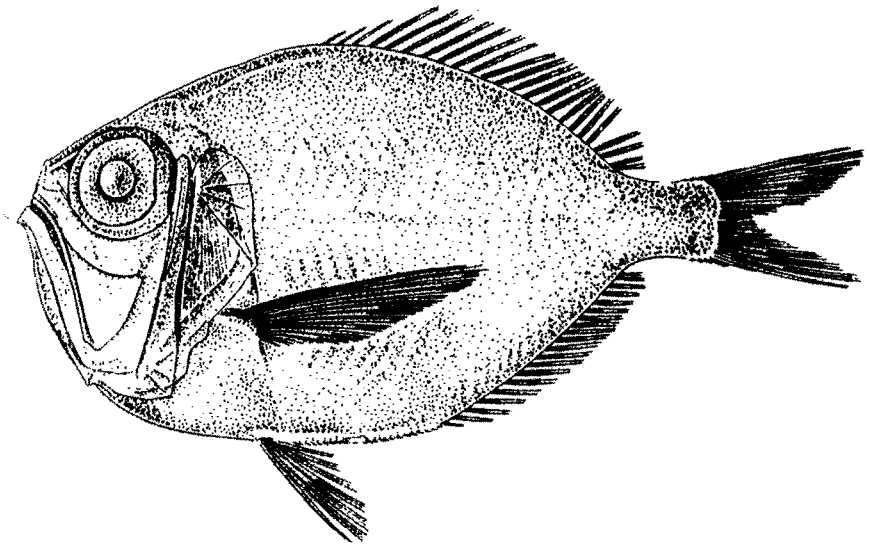

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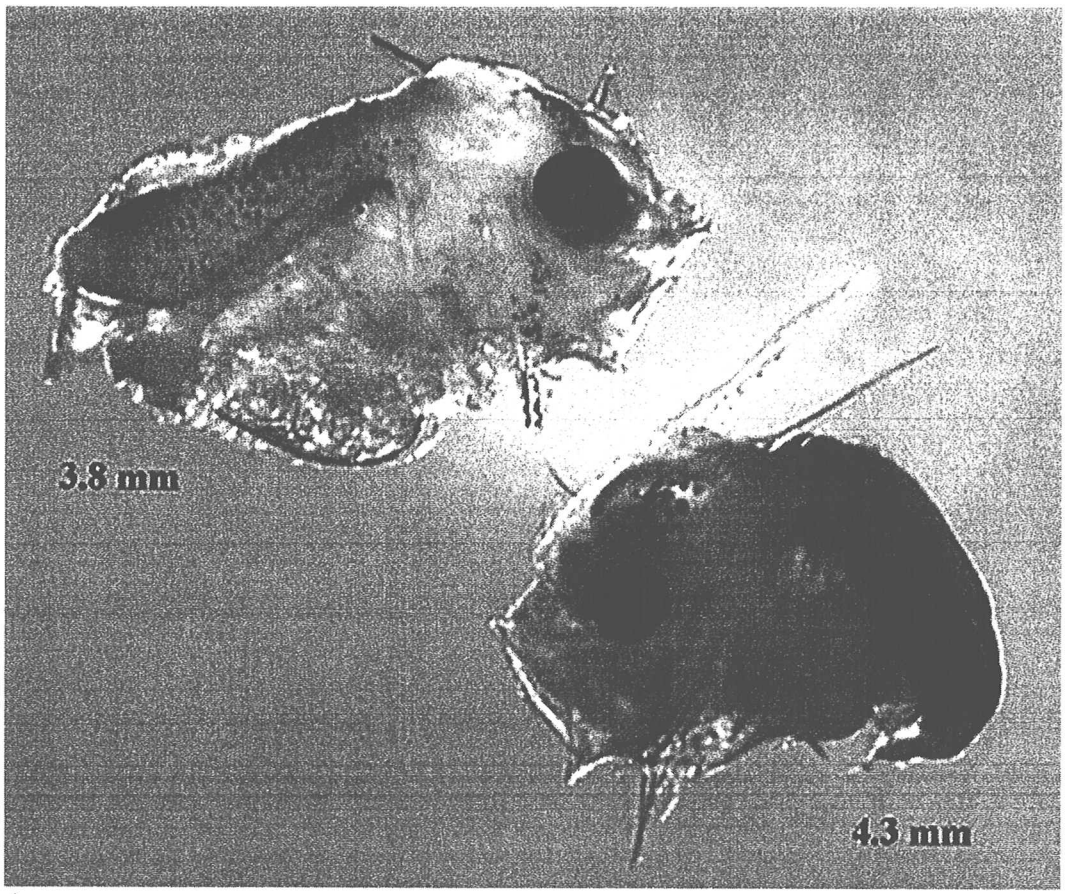
Figure Diretmidae 3. Illustrations of *Diretmichthys parini* ELH stages. A) *Diretmichthys parini* 3.8 mm (upper) & 4.3 mm from Lyczkowski-Shultz et al. (2000); B-I) Series of young stages from Post & Quero (1981): B – ca. 4.2 mm NL, C – ca. 5.8 mm SL, D – ca. 7.5 mm SL, E – ca. 10.7 mm SL, F – ca. 16 mm SL, G – ca. 28 mm SL, H – ca. 60 mm SL, & I – ca. 230 mm SL.



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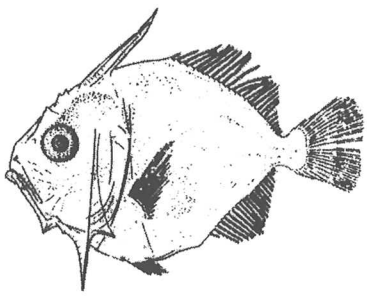

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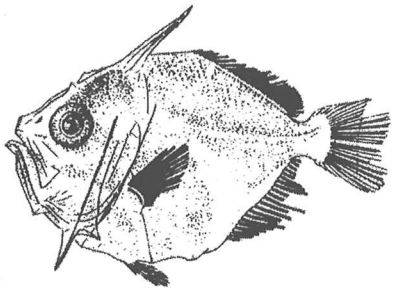

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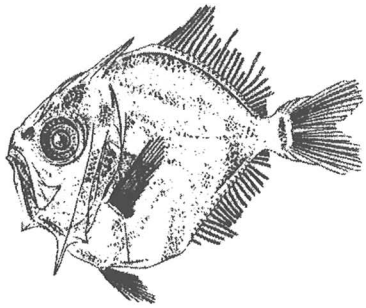

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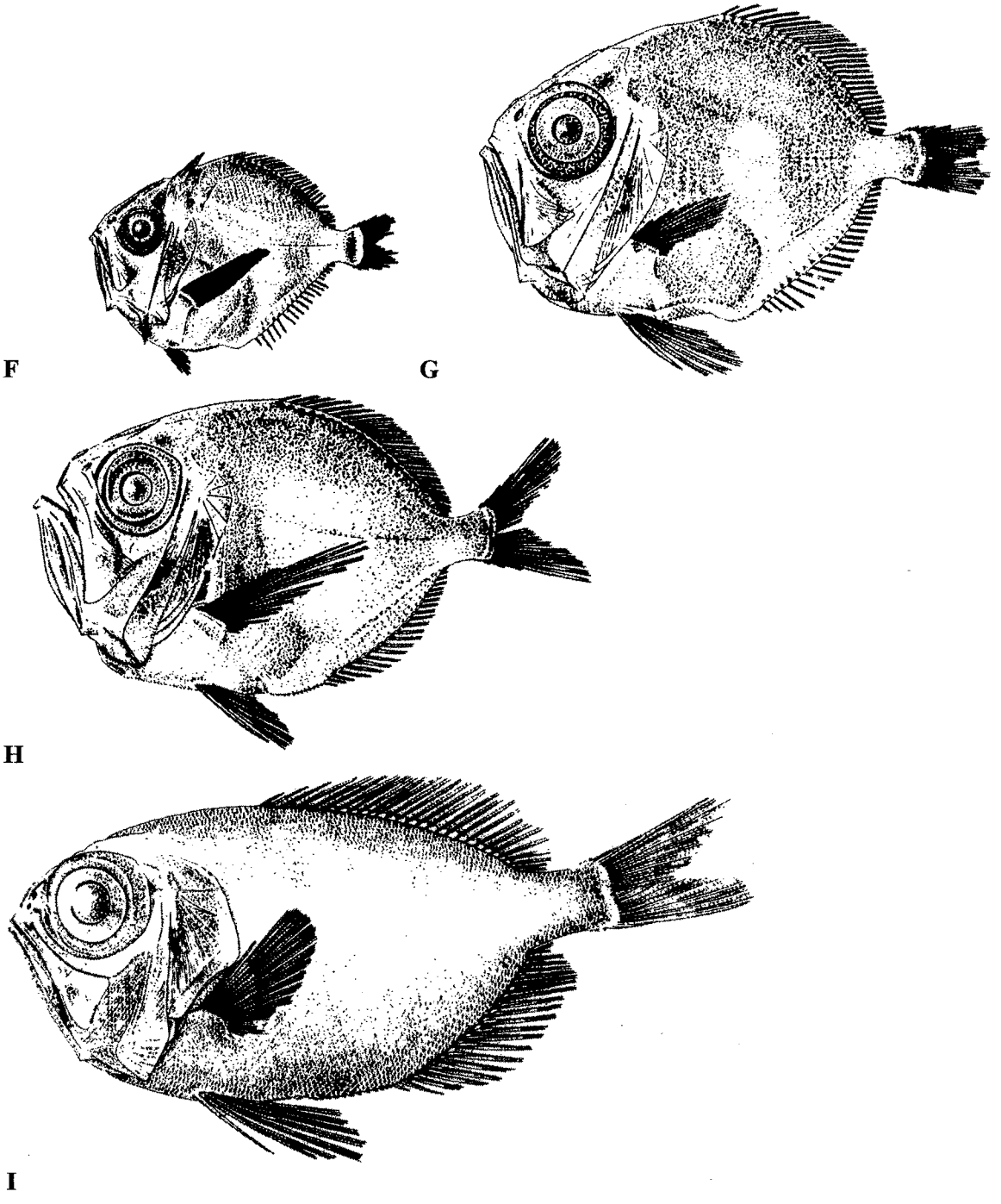


The family comprises two subfamilies (Holocentrinae, the squirrelfishes and Myripristinae, the soldierfishes) in our area. They are the only nocturnal, shallow to moderately deep-water beryciform fishes and are often associated with coral & rocky reefs (Nelson 1994). Lyczkowski-Shultz et al. (2000) briefly listed Gulf of Mexico species and reviewed what little is known about the ELH stages. On a worldwide basis Tighe & Keene (1984) reviewed the ELH information of the family and Kotylar (1998) reviewed the adult species and their distributions. In our area there are three Holocentrinae genera (*Holocentrus, Neoniphon*, and *Sargocentron*) and four Myripristinae genera (*Myripristis, Ostichthys, Corniger,* and *Plectrypops).* Only one genus (*Pristilepis*) is not represented in our waters thus larval identifications from outside our area are helpful. The only problem is that little progress has been made on specific identifications.

Larvae from the two subfamilies are easily separable as the Holocentrinae have a single rostral spine and late forming pelvic fins, whereas the Myripristinae have a bifurcate rostral spine and early forming pelvic fins (Lyczkowski-Shultz 2000). These larvae are separable from most other families by the strong development of supraoccipital spine and rostral spine while other percoid families with strong supraoccipital spines (priacanthids and lobotids) lack rostral spines. Several families have rostral spines but these are usually bilateral (peristediids and triglids). Holocentrids have a pelagic transition, presettlement stage termed the "rhynchichthys stage" with full adult fin counts but remnants of the rostral spine. In addition some species have a distinctive, stream lined prejuvenile phase termed the "meeki stage" (Tyler et al. 1993).

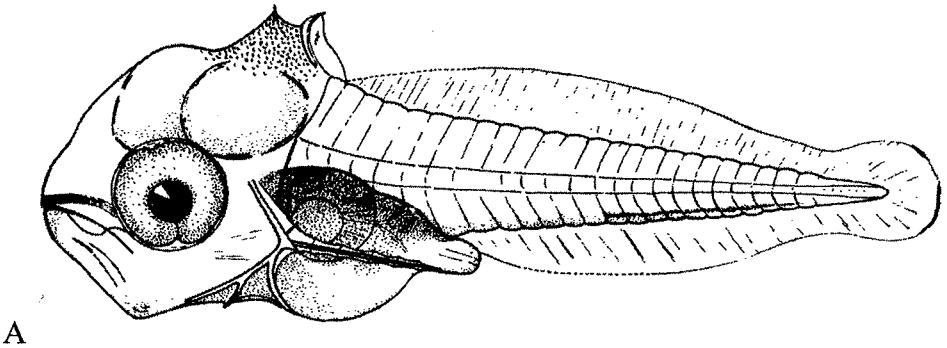
In our area only one species, *Sargocentron vexillarium* has had a complete series described (McKenney 1959). Holocentrids are very similar morphologically with little meristic variation as seen in Table Beryciformes 1. Robins & Ray (1986) use color patterns almost exclusively to separate the species and Woods & Sonoda (1973) use fin element lengths and other body parts sizes in their key to the species. Woods & Sonoda (1973) have transposed two figures – Fig. 32 and 35 for the species *H. adscensionis* and *H. rufus*. We raise this point of species similarity to bring into question whether or not McKenney's (1959) study dealt with a complex of Holocentinae species. McKenney (1959) noted that he saw some larvae with black pigment in the dorsal fin that he referred to other species. Species lacking prominent black areas on the first dorsal fin include *H. adscensionis, H. rufus, N. marianus, & S. vexillarius*. Species with distinct black pigment in the first dorsal fin include *S. bullisi, S. poco, & S. coruscum.*

The four species of Myripristinae are believed to all have a bifurcate rostral spine. In our examination of many holocentrid larvae, those with single rostral spines generally look like *S. vexillarium* thus until a thorough study of many specimens is undertaken it is premature to give specific names or even generic names to larval forms. Meristics are given in Table Beryciformes 1, adult distribution in Table Holocentridae 1, and some representative illustrations of ELH stages are shown in Figure Holocentridae 1.

Table Holocentridae 1. Geographic distribution of adults based on Kotylar (1998), Robins & Ray (1986), and Woods & Sonoda (1973)

Species	Geographic Dsitribution
Holocentrus	
adscensionis	North Carolina, Bermuda, southern Gulf of Mexico, Caribbean Sea, south to Santos, Brazil including St. Peter & Paul's Rocks, & the eastern Atlantic.
rufus	South Florida, Bermuda, Bahamas, south to northern South America; absent from Florida Keys & Gulf of Mexico.
Neoniphon	
marianus	Florida Keys, Bahamas south through Caribbean to Trinidad.
Sargocentron	
vexillarium	South Carolina, Bermuda, Florida, Campeche, & throughout Caribbean Sea in offshore deep water (30-110 m).
coruscum	Florida, Bermuda, Campeche Bank, Bahamas, & throughout Caribbean
bullisi	North Carolina south to Surinam, throughout Caribbean, Gulf of Mexico, Bermuda
poco	Off Texas, Campeche Bank, Bahamas, Cuba, Grand Cayman, Virgin Islands
Myripristis	
jacobus	North Carolina, Bahamas, nortern Gulf of Mexico, Caribbean Sea south to Brazil, & the eastern Atlantic.
Ostichthys	
trachypoma	New York south to northern Gulf of Mexico, Caribbean Sea & south to Brazil.
Corniger	
spinosus	Disjunct distribution from South Carolina, Florida east coast, Cuba & Rio de Janeiro, Brazil in deep rocky slopes (42-275 m).
Plectrypops	
retrospinis	New Jersey south to northern Gulf of Mexico, Bermuda, Caribbean Sea, & south to Brazil.

Figure Holocentridae 1. Representative illustrations of larval holocentrids. A) *S. vexillarium* 1.8 mm, early preflexion stage, from McKenney 1959; B) *S. vexillarium* 5.8 mm, flexion stage, from McKenney 1959; C) *S. vexillarium* 24.9 mm, meeki stage, from McKenney 1959; D) Myripristinae preflexion stage, 2.9 mm, from Lyczkowski-Shultz 2000; & E) Myripristinae flexion stage, 3.9 mm, from Lyczkowski-Shultz 2000.



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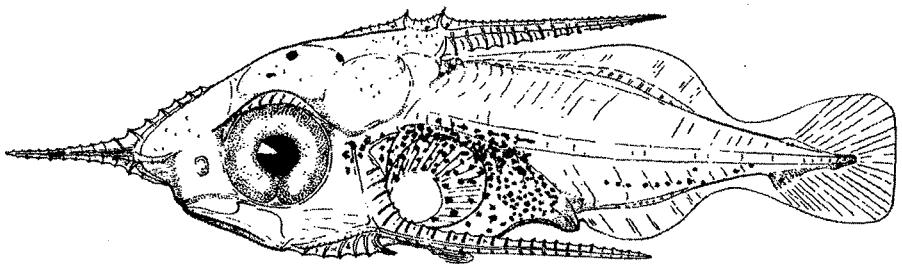

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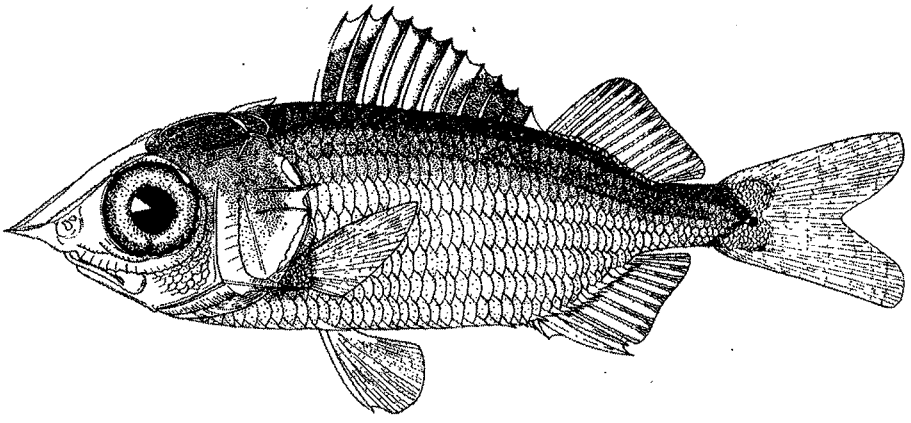

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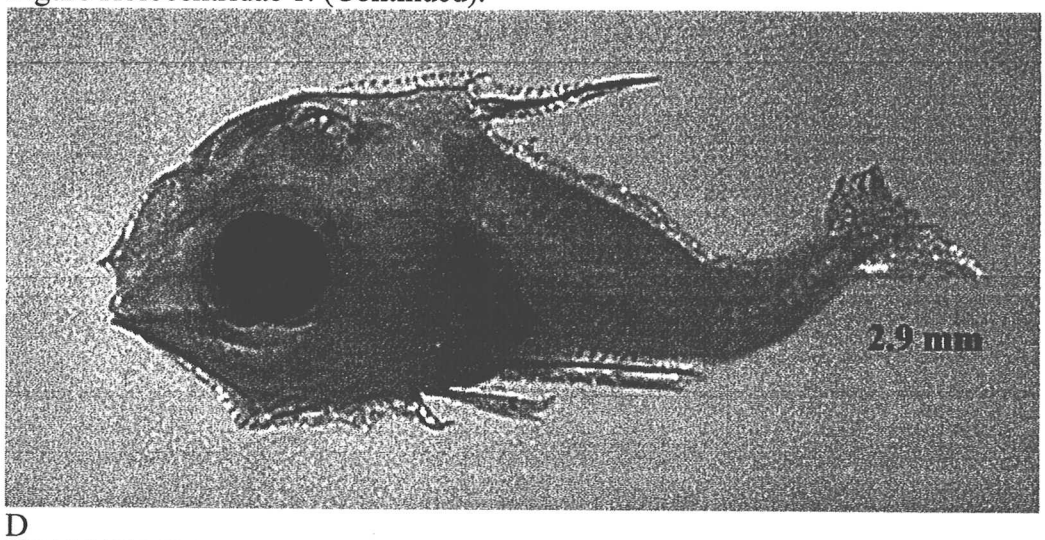
Figure Holocentridae 1. (Continued).



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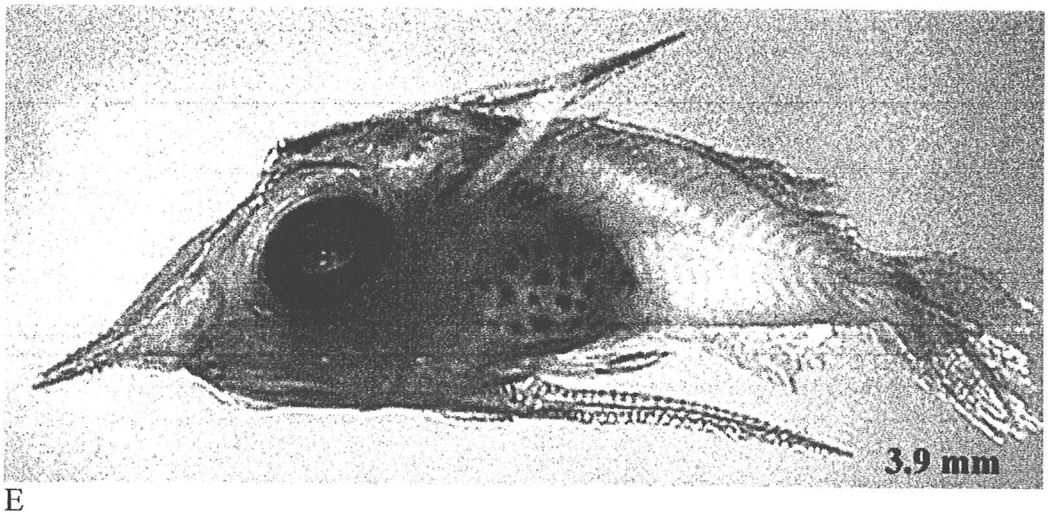


E

TRACHICHTHYIDAE: Roughies by W. J. Richards, J. Lyczkowski-Shultz, & M. Konieczna

This family of moderately deep-sea fishes has four species in three genera in our area. Some species are commercially important but no fisheries exist in our area (the valuable orange roughy, *Hoplostethus atlanticus*, harvested outside of our area does not occur in commercial quantities in the Atlantic). The species represented are *Geophryberyx darwini*, *Hoplostethus mediterraneus*, & *H. occidentalis*, and *Paratrachichthys argyrophanus*. Woods & Sonoda (1973) provide much information on the adults and meristic characters are given in Table Beryciformes 1 and geographic range and depth data are given in Table Trachichthyidae 1. The tables include information on *Hoplostethus atlanticus* as this species is found to the immediate north of our area (see Moore 2002), but since so little is known, young stages may be present in our area.

Larvae have been described for *Hoplostethus* sp from Japan by Konishi & Okiyama (1997). They are reproduced here in Figure Trachichthyidae 1 together with two Atlantic trachichthyids that are possibly *Hoplostethus* originally attributed to *Korogaster nanus* [the juvenile form of *Hoplostethus mediterraneus* (Keene & Tighe 1984)], a post larvae from the Straits of Florida, and a photo of an unidentified trachichthyid from Lyczkowski-Shultz et al. (2000). The young stages of the Pacific *Gephyroberyx japonicus* are also shown, as it is probably similar to the Atlantic *Gephyroberyx darwini*. We also depict the illustrations of *Paratrachiuchthys* sp. from Australian waters from Jordan & Bruce (1998) as an example of that genus that also occurs in our area. Jordan & Bruce (1993) describe early stages of *H. atlanticus* from Australian waters as well. Both Konishi & Okiyama (1997) and Baldwin & Johnson (1995) note that trachichthyids may be paraphyletic thus relationships of this family are unresolved. These authors also include illustrations of trachichthyid larvae.

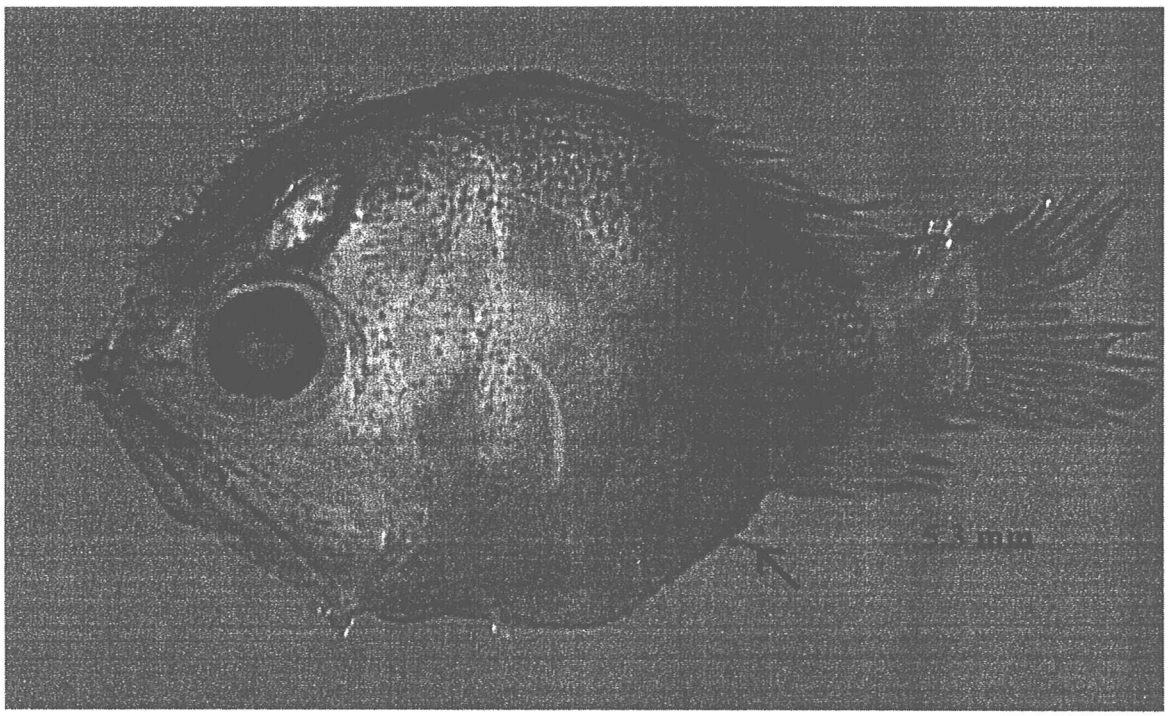
Identification of young stages must await collection of sufficient specimens to obtain good developmental series. At present they can be characterized by their meristics and general morphological features of relatively deep, laterally compressed bodies; small spines on the head, on scales (first appearing in the predorsal area), on trunk scales as they develop (lateral line scales bear two spines), and on the bases of the dorsal fin rays; and well developed pelvic fins. The head bones are heavily spined with the preopercle bearing a series of spines on a ridge on the margin, spines on the opercle margin, interopercle and subopercle, and posttemporal. Variation in head spines among the genera is listed by Baldwin & Johnson (1995). Lyczkowski-Shultz et al. (2000) also note the presence of a small preanal fin, but others have not noted this feature although it can be seen on specimens of *Hoplostethus* sp. (5.4 & 10.7 mm) and *G. japonicus* (4.6 mm) illustrated in Konishi & Okiyama (1997).

Trachichthyid larvae could possibly be confused with carangid larvae that also have deep, compressed bodies or with other beryciforms. Malacanthids of the genus *Lopholatilus* have spines on their heads, but are not laterally compressed or deep bodied. Jordan & Bruce (1998) also note that they are similar to bramids and phycids, but in both cases the similarities are not strong and meristic characters separate them (refer to appropriate tables).

Table Trachichthyidae 1. Geographic and depth ranges of the Family Trachichthyidae

Species	Geographic Range	Depth Range
Gephyroberyx		
darwini	Western North Atlantic from Delaware Bay south to Greater Antilles, western Caribbean & Panama. Also eastern Atlantic, Indian Ocean & southern Australia	182-366 m (40-549 m)
Hoplostethus		
atlanticus	outside of area, found in North Atlantic north of our area.	300-1557 m
mediterraneus	Western North Atlantic on continental shelves from New Jersey south to Greater Antilles, rare in Gulf of Mexico & western Caribbean. Also in Eastern Atlantic, Mediterranean, and western Indian Ocean.	320-457 m rarely to 951 m 35 mm juvenile in 1463 m
occidentalis	Northern Gulf of Mexico, Florida, Bahamas, western & southwestern Caribbean Sea, and Guianas. More abundant in Gulf of Mexioc & Caribbean than *H. mediterraneus*.	366-457 m range 256-549 m
Paratrachichthys		
argyrophanus	Known only from the offshore continental shelf north of the Amazon river mouth, northern Brazil	115-229 fms

Figure Trachichthyidae 1. Illustrations of representative early stages of the Family Trachichthyidae. A) unidentified trachichthyid from the Gulf of Mexico from Lyczkowski-Shultz et al. (2000) (arrow points to preanal fin); B) unidentified trachichthyid from the Straits of Florida, CA891455005, 5.3 mm SL; C-E) *Hoplostethus* sp. larvae from the Pacific from Konishi & Okiyama (1997), 5.4 mm NL, 9.6 mm SL, & 10.7 mm SL, respectively; F-G) juvenile *Hoplostethus* sp. from Baldwin & Johnson (1995), 21.5 mm SL & 18.0 mm SL, respectively; H-J) larvae of the Pacific species, *Gephyroberyx japonicus* from Konishi & Okiyama (1997), 4.5 mm NL, 4.6 mm SL, & 11.0 mm SL, respectively; K-O) larval Pacific *Paratrachichthys* sp. from Jordan & Bruce (1998), 3.9 mm NL, 4.3 mm NL, 4.7 mm NL, 5.5 mm NL, & 7.8 mm SL (arrows depict location of anus); & P) *Hoplostethus atlanticus* 26 mm from Jordan & Bruce (1998).



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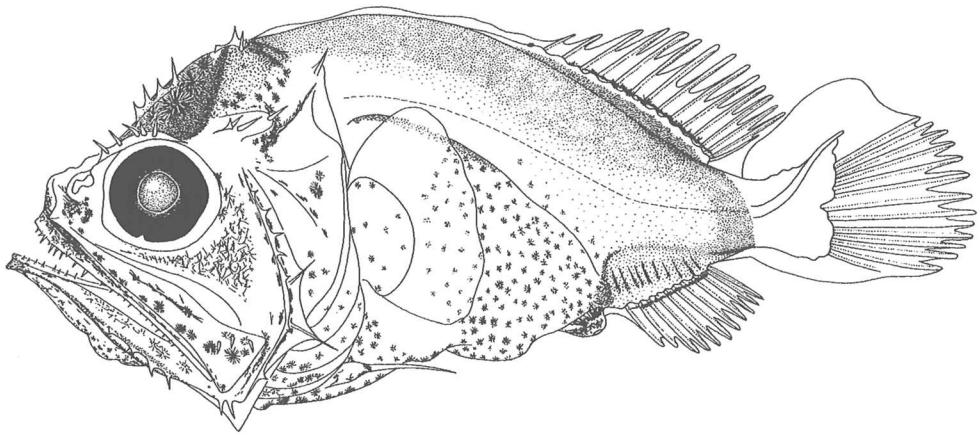

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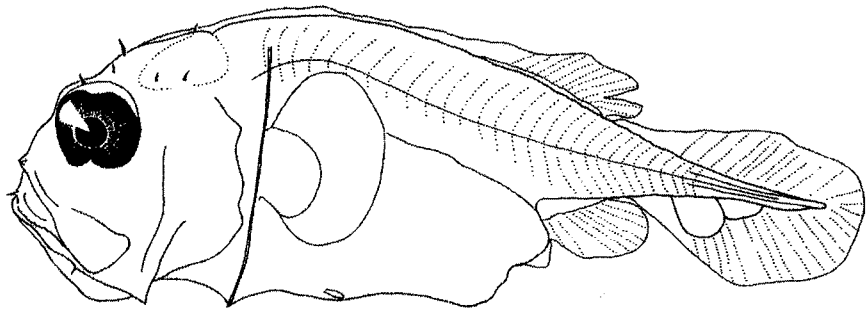

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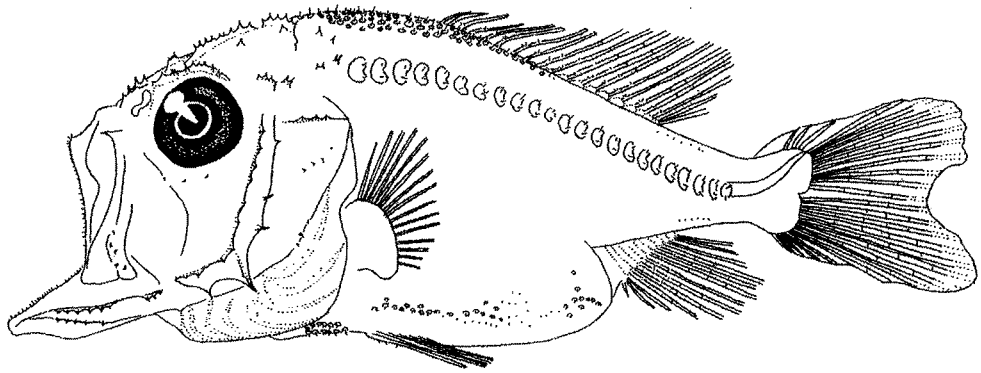

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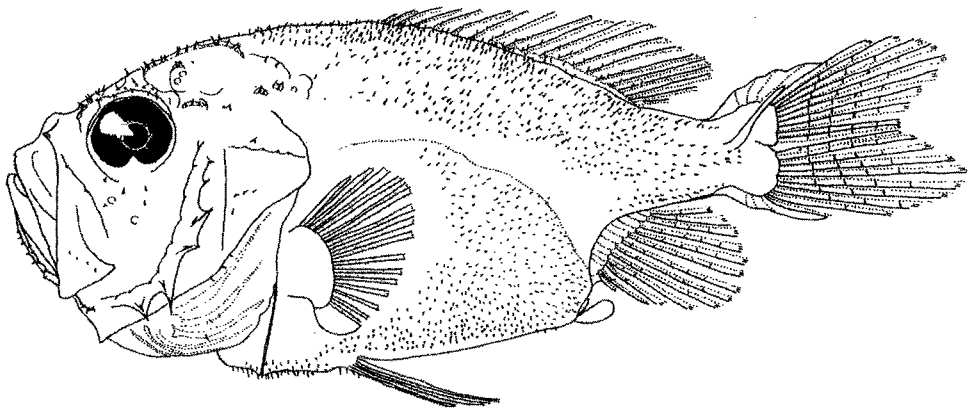

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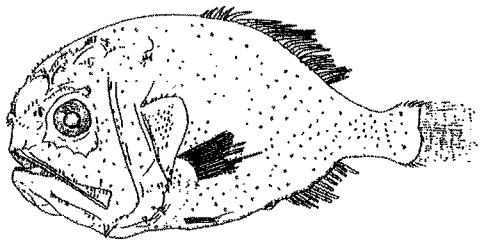

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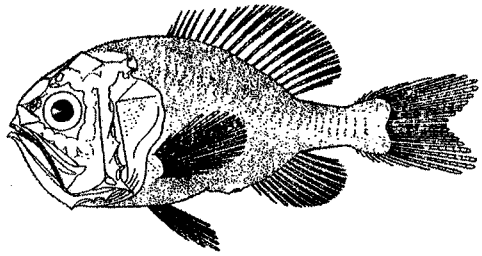

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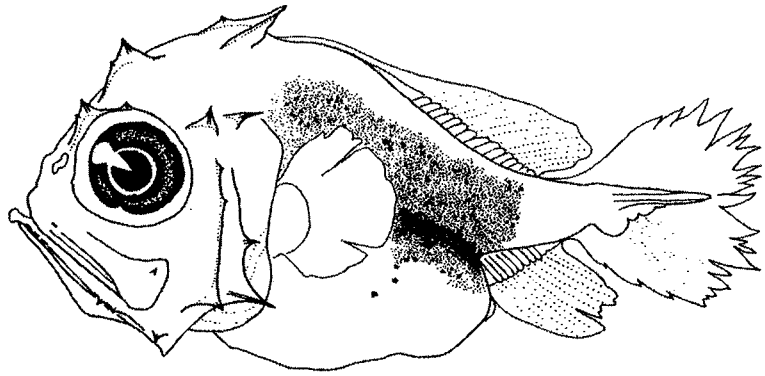

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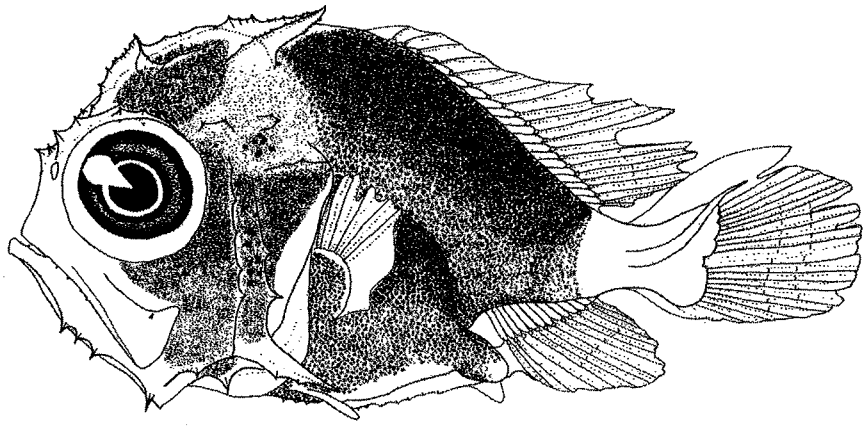

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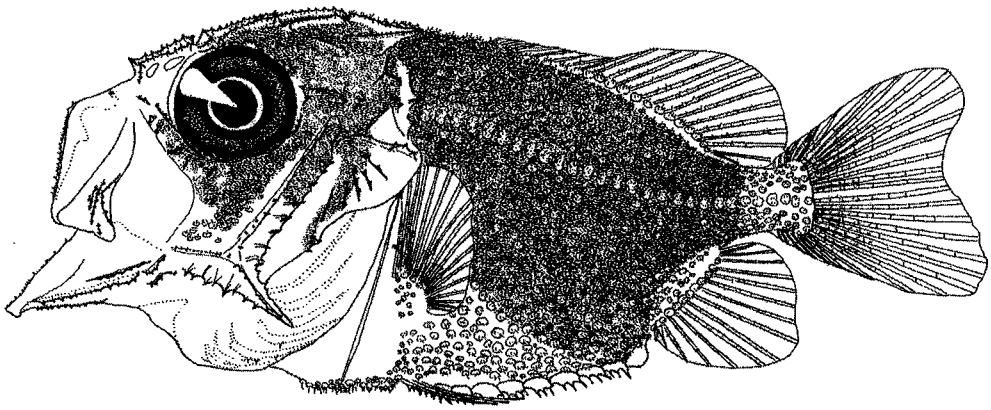

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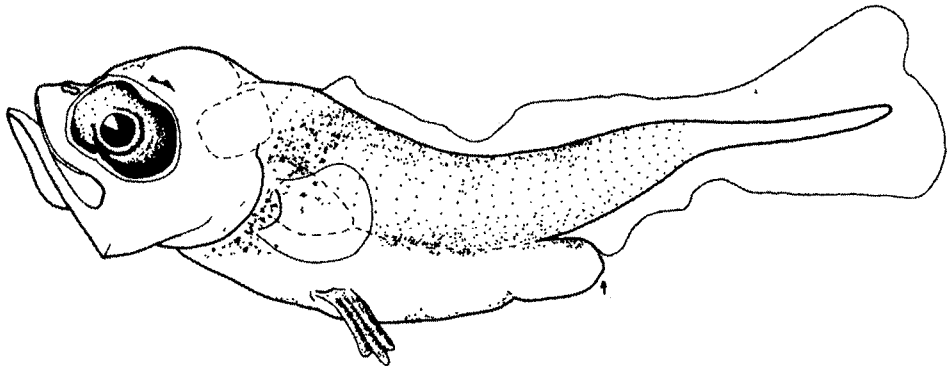
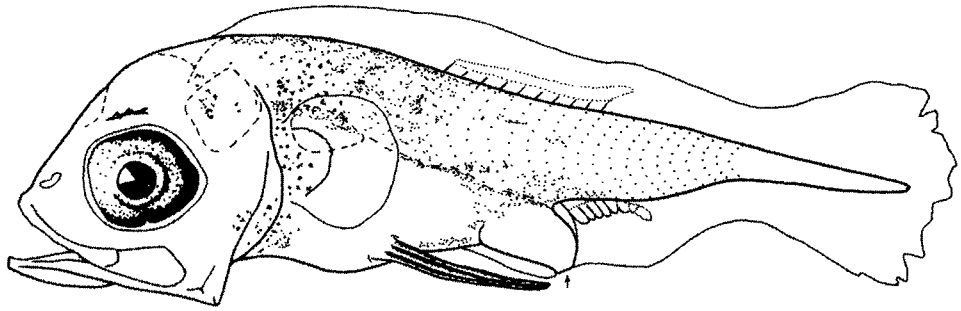


K



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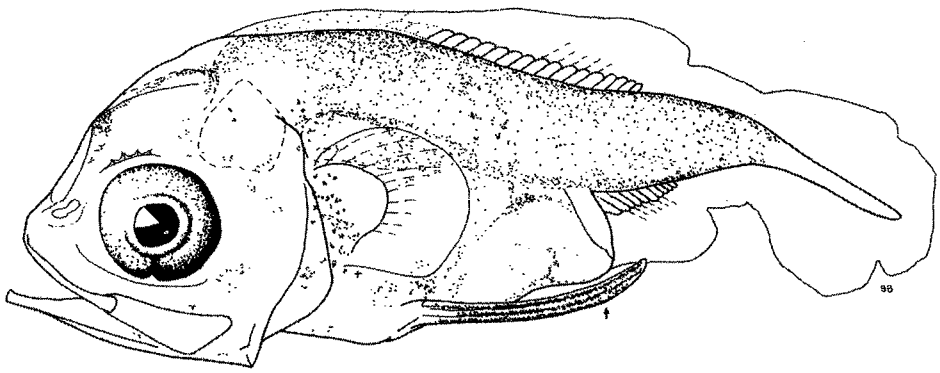

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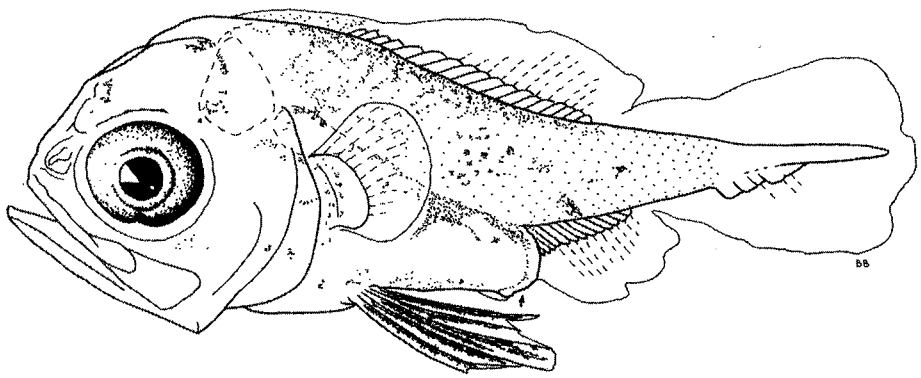

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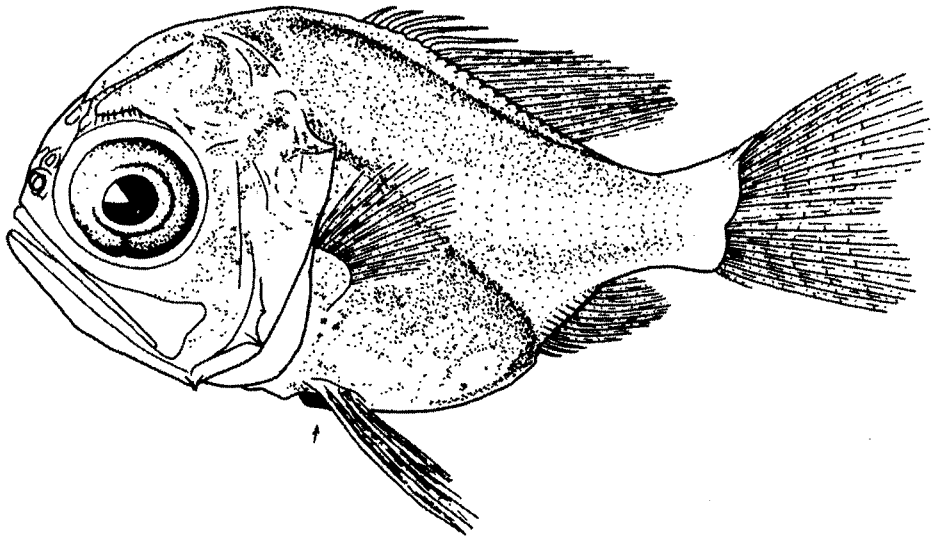

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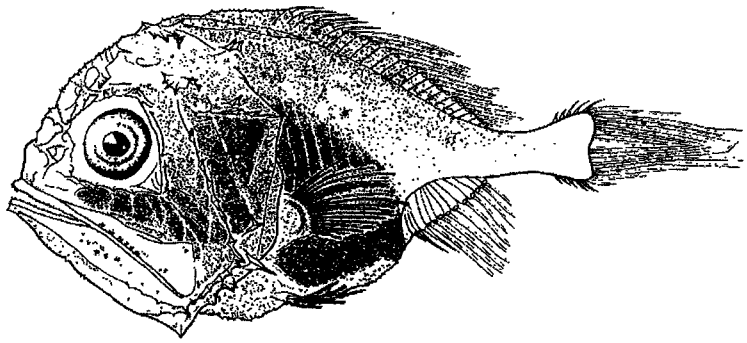

P

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